THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

SOUTHERN RESEARCH INSTITUTE

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**ROD PACKING STATIC SEALING DEVICE**		
APPLICATION:	**SECONDARY SEALING SYSTEM FOR RECIPROCATING COMPRESSOR ROD SEALS DURING STANDBY OPERATIONS**		
TECHNOLOGY NAME:	**Static Pac™**		
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The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations, stakeholder groups which consist of buyers, vendor organizations and permitters, and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Greenhouse Gas (GHG) Technology Verification Center (the Center), one of 12 technology areas under ETV, is operated by Southern Research Institute, in cooperation with EPA's National Risk Management Research Laboratory. The Center has recently evaluated the performance of the Static Pac™ System. This verification statement provides a summary of the test results for the C. Lee Cook Division, Dover Corporation Static Pac™ System.

TECHNOLOGY DESCRIPTION

In the natural gas industry, methane leaks from reciprocating compressors occur from several emission sources, including blowdown valves, rod packing, unit isolation valves, pressure relief valves, and other small fugitive sources. A large source of these emissions is the leakage associated with compressor rod packing. Gas can leak from compressor rod packing while the compressor is in operation and, in some cases, when the compressor is in standby mode. Standby operating mode is commonly encountered in the industry, and is done to ensure that compressors can quickly return to operation in response to changing pipeline demand. If rod leaks during standby operations are reduced or eliminated, significant gas savings and emissions reductions could occur. The C. Lee Cook Static Pac™ device is intended to provide this benefit.

The Static Pac™ is a gas leak containment device designed to prevent rod packing leaks from escaping into the atmosphere during pressurized compressor standby periods. The Static Pac™ system is installed in a conventional packing case by replacing several rings (typically two) in the low-pressure side of the packing case. Upon shutdown of the compressor, the compressor control system activates the Static Pac™ control system and a pressurized gas is used to move a piston along the outer shell of the Static Pac™ seal, wedging a lip seal into contact with the rod. When the actuating pressure is lowered, the piston retracts, releasing the Static Pac™ seal.

VERIFICATION DESCRIPTION

The Static Pac™ was verified at a natural gas compressor station operated by ANR Pipeline Company. The test was carried out on two engines (8-cylinder, 2000 hp), each with two reciprocating compressors operating in parallel (4-inch rods). The evaluation focused on two shutdown procedures that represent the most common approaches to compressor shutdown: (1) remain pressurized during standby periods and (2) depressurized (blowdown) before standby. The goals of the verification test were to: (1) verify Static Pac™ gas savings, and (2) document initial costs and installation requirements. To accomplish this, the Static Pac™ was installed on a single rod on the two engines. The remaining rod, equipped with conventional packing, served as a Control Rod against which Static Pac™ performance was compared. The Control Rod packing was outfitted with new seals at the same time the Static Pac™ was installed, facilitating a more direct comparison between the Test and Control Rods. Emissions from other equipment whose leak rates are affected by the standby mode were also measured; these include the blowdown valve, pressure relief valve, unit valves, and other miscellaneous sources that impact the gas savings.

This Verification Statement summarizes Phase I test results, which consist of initial installation data and measurements collected between July 15 and August 6, 1999. Conclusions presented in this statement are based on direct measurements, station operational logs, cost data submitted by site operators and C. Lee Cook, and interviews with site operators. Rod packing emission reduction performance is based on five measurements which span the time from when the packing was new until it had logged about 1900 hours of wear. Fugitive emissions from components exposed to pressurized conditions were also measured during this period. No detectable emissions were measured from the blowdown valve and the pressure relief valve. The overall average emission rate for the unit valves was 4.86 scfm natural gas (combined for two compressors). The blowdown volume for each compressor unit was 9,200 scf natural gas (700 psig suction pressure). During the Phase I evaluation period, the two test engines were on standby for 116 hours (14 percent of the time), and a total of three blowdowns occurred.

The Static Pac™ will be tested continuously for an additional 4 months. A Phase II report containing medium-term technical and economic performance verification results will be issued at the conclusion of the test. The verification test design, measurement procedures, and quality assurance/quality control (QA/QC) procedures are characterized in the following Test Report: *Testing and Quality Assurance Plan for the C. Lee Cook Division, Dover Corporation Static Pac™ System, July 20, 1999*. Full Phase I verification results may be found in the report titled *Environmental Technology Verification Report, C. Lee Cook Division, Dover Corporation Static Pac™ System, Phase I*. Both reports have been reviewed by C. Lee Cook, ANR Pipeline Company, selected members of the Center's Oil and Gas Stakeholder group, and the EPA QA Team. The reports may be downloaded from the ETV Program or Center Web sites (www.epa.gov/etv or www.sri-rtp.com).

VERIFICATION OF PERFORMANCE

Rod Packing Emission Reduction Performance:

- Methane Emissions During Standby: The Static Pac™ reduced 96 percent of the rod packing emissions while the compressor was in an idle, pressurized state. The overall methane emission reduction achieved was 0.66 scfm.

- Methane Emissions During Compressor Operation: The Static Pac™ requires removing a seal to make room for the Static Pac™ components, resulting in a "missing seal" compared to a conventional packing. It has been speculated that an increase in rod emissions may occur during compressor operation as a result of this missing seal. No differences in running emissions were measured between the Test Rods and Control Rods (average emission rates were 0.68 scfm methane for both packing types), indicating that the missing seal does not increase normal operating emissions.

Gas Savings For Baseline Operating Practices:

- Gas Savings for a Compressor that Normally Remains Pressurized During Standby Periods: As a result of installing the Static Pac™ on the two Test Rods, gas savings were 4,733 scf natural gas for a standby period equal to 116 hours. This is equivalent to 41 scf natural gas savings/standby hour for each Test Rod.

- Gas Savings for a Compressor that Normally Depressurizes and Blows Down to Atmospheric Pressure: As a result of installing the Static Pac™ on both Test Rods and maintaining a 700 psig idle pressure, gas savings were 61,217 scf natural gas for a standby period equal to 116 hours and 3 blowdown occurrences. This is equivalent to 528 scf natural gas/standby hour for each Test Rod. The change in operating characteristics, particularly those due to the elimination of the blowdown volume, provided significant benefits to this baseline scenario.

Static Pac™ Capital and Installation Costs:

- Net Initial Costs: The capital cost for the Static Pac™ system was $2,638/rod greater than the cost for a conventional packing case. Installation of the Static Pac™ required 13 hours/rod more than the conventional packing. The incremental costs for modifying a conventional packing case with the Static Pac™ was $3,483/rod.

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